Practitioner's Docket No. 67,200-613 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Tsai, et al.		
Serial No.	10/050,322	Group No.:	1756
Filed:	Jan. 15, 2002	Examiner:	N. M. Barreca
		In Response to Office Action Dated: 07/07/2005	

For: A Bi-Layer Photoresist Dry Development and Reactive Ion Etch Method

Mail Stop: Appeal
Commissioner for Patents
P O Box 1450
Alexandria, VA 22313-1450

SPECIAL NOTICE TO EXAMINER:
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TRANSMITTAL OF SECOND APPEAL BRIEF (PATENT APPLICATION 37 CFR 192)

1. Transmitted herewith, via facsimile, is the SECOND APPEAL BRIEF in this application with respect to the Second Notice of Appeal filed on July 20, 2005 and the First Notice of Appeal filed on August 30, 2004.

2. STATUS OF APPLICANT

This application is on behalf of
☒ other than a small entity.
☐ a small entity.

08/05/2005 TL0111 00000006 10050322
01 FC:1402 500.00 OP

A verified statement
☐ is attached.
☐ was already filed on _____.

3. FEE FOR FILING SECOND APPEAL BRIEF
Pursuant to 37 C.F.R. 1.17(e) the fee for filing the Second Appeal Brief is:

☒ Fee Previously Submitted with First Appeal Brief on 10/28/04 ($340.00)
☐ small entity $250.00
☒ other than a small entity $500.00

Adjustment date: 08/05/2005 TL0111
11/02/2004 ABONDAF1 00000077 10050322
01 FC:1402 -340.00 OP

Appeal Brief fee due: $160.00 (Difference due to New Fee Rates ($340 paid to PTO on 10/28/04)

pg 4 wasn't received

CERTIFICATE OF MAILING OR FACSIMILE TRANSMISSION (37 C.F.R. 1.8a)

I hereby certified that this correspondence is (1) ☐ being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to the Commissioner for Patents, P O Box 1450, Alexandria, VA 22313-1450 on August ____, 2005; or (2) ☒ being facsimile transmitted to the United States Patent and Trademark Office at facsimile number (571)-273-8300 on August 4, 2005.

Randy W. Tung — Printed Name
Signature
8/4/05 — Date

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TUNG & ASSOCIATES
838 W. Long Lake Road, Suite 120
Bloomfield Hills, MI 48302

4. EXTENSION OF TERM

NOTE: The time periods set forth in 37 C.F.R. 1.191 are subject to the provision of §1.136 for patent applications. 37 C.F.R. 1.191(d). (But see 37 C.F.R. 1.645 for extension of time in interference proceedings and 37 C.F.R. 1.550(c) for extension of time in reexamination proceedings).

(complete (a) or (b), as applicable)

The proceedings herein are for a patent application and the provisions of 37 C.F.R. 1.136 apply.

(a) ☐ Applicant petitions for an extension of time under 37 C.F.R. 1.136 (fees: 37 C.F.R. 1.17(a)-(d) for the total number of months checked below:

	Extension (months)	Fee for other than small entity	Fee for small entity
☐	one month	$ 120.00	$ 60.00
☐	two months	$ 450.00	$225.00
☐	three months	$ 1,020.00	$510.00
☐	four months	$ 1,590.00	$795.00

Fee $ 0.00

If an additional extension of time is required, please consider this a petition therefor.

(check and complete the next item, if applicable)

☐ An extension for _____ months has already been secured. The fee paid therefore of $_____ is deducted from the total fee due for the total months of extension now requested.

Extension fee due with this request $_____

or

(b) ☐ Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

5. TOTAL FEE DUE

Appeal Brief fee $ 160.00
Extension fee (if any)$ 0.00

TOTAL FEE DUE: $ 160.00

6. FEE PAYMENT

☒ Attached is a Credit Card Payment Form in the sum of $160.00.
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A duplicate copy of this transmittal is attached.

7. FEE DEFICIENCY

NOTE: If there is a fee deficiency and there is no authorization to charge an account, additional fees are necessary to cover the additional time consumed in making up the original deficiency. If the maximum, six-month period has expired before the deficiency is noted and corrected, the application is held abandoned. In those instances where authorization to charge is included, processing delays are encountered in returning the papers to the PTO Finance Branch in order to apply these charges prior to action on the cases. Authorization to charge the deposit account for any fee deficiency should be checked. See the Notice of April 7, 1986, 1065 O. G. 31-33.

☐ If any additional extension and/or fee is required, charge Deposit Account No. _____ (a duplicate copy of this letter is enclosed).

AND/OR

☐ If any additional fee for claims is required, charge Account No. _____. (a duplicate copy of this letter is enclosed).

Signature of Practitioner
Reg. No. 31,311
Randy W. Tung
Tel. No. (248) 540-4040
Tung & Associates
838 W. Long Lake Road - Suite 120
Bloomfield Hills, Michigan 48302

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicants: Tsai et al. Group Art Unit: 1756

Serial No.: 10/050,322 Examiner: N. M. Barreca

Filed: 01/15/2002 In Response to Office Action Dated: 07/07/2005

For: A BI-LAYER PHOTORESIST DRY DEVELOPMENT AND REACTIVE ION ETCH METHOD

Attorney Docket No.: 67,200-613

CERTIFICATE OF MAILING OR FACSIMILE TRANSMISSION

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Randy W. Tung (Printed Name) _____ (Signature) 8/4/05 (Date)

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TUNG & ASSOCIATES
838 W. Long Lake Road, Suite 120
Bloomfield Hills, MI 48302

Second APPEAL BRIEF

Box Appeal
Commissioner for Patents
Washington, D.C. 20231

Sir:

APPELLANTS appeal in the captioned application from the Examiner's final rejection, dated 04/13/2005, of claims 1, 3, 5, 7, 11-13, 23-26, and 30-38.

It is urged that Examiners final rejection be reversed and that all the claims currently pending be allowed.

(1) REAL PARTY IN INTEREST

The real party in interest in the present appeal is the recorded Assignee, Taiwan Semiconductor Manufacturing Company, Ltd.

(2) RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences that are known to the Appellant, the Appellant's legal representative, or the assignee.

(3) STATUS OF CLAIMS

Claims 1, 3, 5, 7, 11-13, 23-26, and 30-38 are pending in the Application.

Claims 2, 4, 6, 8-10, 14-22, and 27-29 have been cancelled.

Claims 1, 3, 5, 7, 11-13, 23-26, and 30-38 stand rejected.

APPELLANTS appeal from the rejection of claims 1, 3, 5, 7, 11-13, 23-26, and 30-38.

(4) STATUS OF AMENDMENTS

A first amendment was filed by Applicants on or about 3/17/2004.

A Request for Reconsideration from Final Rejection was mailed on or about 7/28/2004 including proposed amendments which were not entered according to an Advisory Action was mailed on 8/24/2004.

A first supplemental amendment was mailed on or about 10/27/2004 and entered.

A first Appeal brief was mailed on or about 10/30/2004.

An Office Action re-opening prosecution was mailed on or about 12/16/2004.

An Office Action in reply to the re-opened prosecution was mailed on or about 2/17/2005 including proposed amendments which were entered.

A second final rejection was mailed on or about 4/13/2005.

A second Request for Reconsideration was filed on or about 6/30/2005 including proposed amendments which were refused entry in an Advisor Action mailed on or about 7/7/2005.

A Second Supplemental Amendment has been filed prior to the instant Second Appeal Brief on or about 8/7/2005 to overcome Examiners objections and rejections under 35 USC Section 112, 2d paragraph. Although the status of entry is unknown at this time, the Appeal Brief is written with the assumption of entry.

(5) SUMMARY OF CLAIMED SUBJECT MATTER

Independent claims 1, 25, and 32 are directed to a method for a method for etching an opening using a bi-layer photoresist to improve an etching resolution and reduce particulate contamination.

For example, several problems with prior art bi-layer development processes are recognized by Applicants including ashing processes as outlined in paragraph 009 where Applicants recognize the problem of residual particle contamination generated in ashing and etching processes including carry out such processes in separate chambers. Applicants disclosed and

claimed invention is directed to overcome these shortcomings in the prior art.

Independent claim 1 outlines a bi-layer resist mask development process where a first (non-silicon containing) and second resist layers (silicon containing) are formed with a specified thickness followed by a patterning process for the second (upper) resist layer and a dry development process of the first resist layer (lower layer), followed by an etching process, and followed by an in-situ ashing process to remove remaining overlying resist layers.

Independent claim 25 further specifies the bi-layer development process including dry development gases, and applicable wavelengths of exposure of the second resist layer. In addition, claim 25 further outlines in-situ etching, ashing and plasma cleaning steps.

Independent claim 32 further specifies a sequence of in-situ steps following patterning the bi-layer resist including an ashing process to remove the second resist layer, followed by etching an opening, followed by removing the first resist layer by a second ashing process, followed by etching through an underlying resist layer, and followed by a plasma cleaning process.

Figures 1A to 1G show cross sectional side view representations of a portion a semiconductor device according to an exemplary **step wise** manufacturing process as embodied in the various claims. Figure 3 shows an exemplary process flow as embodied in the various claims. Paragraphs 0033 to 0044 outline exemplary process steps with respect to Figures 1A to 1G. Paragraph 0046 outlines the benefits and problems overcome by Applicants disclosed and claimed invention

(6) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 1, 3, 5, 7, 11-13, 23-26, 30-38 stand rejected under 35 USC 103(a) as being obvious over Tsai (US 6,787, 455) in view of Douglas (US 5,545,290). Applicants have filed a statement of common ownership with respect to Tsai thus disqualifying Tsai under 35 USC 103(c). Nevertheless, Applicants traverse Tsai herein.

(8) ARGUMENT

Rejection under 35 USC 103(a)

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Claims 1, 3, 5, 7, 11-13, 23-26, 30-38

Tsai et al. disclose a method for forming an opening using a **bi-layer photoresist** wherein **a dry development process** of an underlying resist layer is carried out using a plasma comprising **oxygen, carbon monoxide, and argon** (see abstract). Nowhere does Tsai disclose or suggest using **nitrogen, oxygen and argon** in the dry development process as Applicants disclose and claim.

On the other hand, Douglas discloses a method for **trench etching** to provide a high level of control over the sidewall profile of the trench and a high degree of selectivity to the etch mask. The method of Douglas is disclosed for etching **silicon and tungsten.** In the silicon etching method, **carbon monoxide or nitrogen** is added to etchant gases such as HBr, HBr/SF_6, BCl_3, and $SiCl_4$ to form a **passivant** over silicon to protect the silicon from etchant gases such as HBr, HBr/SF_6, BCl_3, and $SiCl_4$ (see Abstract). Douglas teaches that the passivant gases include a pi bonding system that create a weak adductive bond to dangling bonds created during etching to the sides of the trench being etched and are not removed due the oblique angle of etching (tapered sidewalls) (see Abstract). The selectivity with respect to silicon etching is achieved since the passivant gasses bond more strongly to the sides of the trenches than the silicon (see

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Abstract).

The etch mask of Douglas is disclosed to be **silicon dioxide or photoresist**. Douglas additionally discloses that the principal of operation of the passivant gases includes "passivating the surface of the silicon substrate and preventing reaction between the silicon substrate and the **halogen atoms** generated from the HBr-based discharge" as well as passivating **resist or silicon dioxide during** the **silicon or tungsten** etching process to improve resistance (selectivity) of the etching mask (**resist or silicon dioxide**) to etching (see e.g., col 1, lines 56 - col 2, lines 12).

Douglas discloses that the passivant gases create weak bonds to the sides of the mask and the trench during dry etching of the trench with **halogen gases** to improve selectivity (resistance to dry etching) of the mask. Moreover, Douglas discloses that a **resist etching mask** is first formed **prior to etching a trench** according to **conventional photolithographic processes** (col 3, lines 1-35) which implies a **wet development process to form the patterned resist mask.**

Nowhere does Douglas disclose **a bi-layer dry development process**, or **a silicon containing resist layer overlying a non-**

silicon containing resist layer, or any other aspect of Applicants disclosed and claimed invention.

There is no apparent motivation for combining the **silicon or tungsten etching process of Douglas** with the **bi-layer resist development process of Tsai et al.** The bi-layer **dry** development process of Tsai et al. works by a different principal of operation than the **in situ passivation trench etching** process of Douglas.

For example, Tsai et al. teach **first forming an etching mask in an upper silicon containing resist layer prior to dry developing** the underlying resist using **carbon monoxide and oxygen** to form a **bi-layer etching mask** for etching an opening. Tsai et al. additionally teach that the upper resist layer **may be removed** by an **ashing process prior** to etching an opening (col 5, lines 55-62). Thus, the combination of the teachings of Douglas including **in-situ passivation a single resist layer** etching mask **during etching of a trench in silicon** following **wet development of a resist mask** with the teachings of Tsai et al. including bi-layer resist dry developing **followed by removal of an uppermost resist layer** by an **ashing process (oxygen) prior to** etching a trench (opening) would destroy the principal of operation of either of the methods of Douglas or Tsai et al.

For example, any combination of the teachings of Tsai et al. and Douglas in an effort to recreate Applicants disclosed and claimed invention would destroy the resist etching mask of Douglas, or destroy the dry development process of Tsai et al., making both methods unsuitable for their intended purpose.

Even assuming *arguendo*, a proper motivation for combining the teachings of Tsai et al. and Douglas, which Applicants do not concede, such combination does not produce Applicants disclosed and claimed invention.

The combination of Tsai et al. and Douglas do not disclose several elements of Applicants disclosed and claimed invention including dry development of a bi-layer resist using **nitrogen, oxygen and argon,** as Applicants have disclosed and claimed.

Rather the use of oxygen in the trench etching process of Douglas would likely remove the single layer resist mask of Douglas, making it ineffective and unsuitable for its intended purpose.

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the

reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).*

"A prior art reference must be considered in its entirety, i.e., as a whole including portions that would lead away from the claimed invention." *W.L. Gore & Associates, Inc., Garlock, Inc., 721 F.2d, 1540, 220 USPQ 303 (Fed Cir. 1983), cert denied, 469 U.S. 851 (1984).*

"If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." *In re Ratti, 270 F.2d 810, 123, USPQ 349 (CCPA 1959).*

"If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." *In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).*

"The mere fact that references can be combined or modified does not render the resultant combination obvious unless the

prior art also suggests the desirability of the combination." *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

Therefore Tsai et al., singly or in combination with Douglas fails to make out a *prima facie* case of obviousness with respect to Applicants disclosed and claimed invention.

CONCLUSION

Examiner has not met the burden of establishing a *prima facie* case of obviousness with the teachings of Tsai in combination with Douglas. Rather, APPELLANTS disclosed and claimed invention has been demonstrated to be nonobvious. None of the cited references, individually or in combination, solve the problem in a way recognized and solved by Applicants.

The fact that Examiner can produce no references, alone or in combination, disclosing or suggesting APPELLANTS disclosed and claimed invention strongly supports a conclusion of patentability.

It is therefore respectfully submitted that Examiners final rejection of Appellants claims is improper under the statutory standard of 35 USC § 103(a) as interpreted by both the Board and the Courts.

U.S.S.N. 10,050,322

The reversal of the final rejection is respectfully solicited from the Board.

Respectfully submitted,

Tung & Associates

By: _____

Randy W. Tung
Registration No. 31,311
Telephone: (248) 540-4040

CLAIMS APPENDIX

1. A method for etching an opening using a bi-layer photoresist to improve an etching resolution and reduce particulate contamination comprising the steps of:

providing an unpatterned non-silicon containing photoresist layer over a substrate to form a first resist layer;

providing a silicon containing photoresist layer on the first resist layer to form a second resist layer thinner than the first resist layer;

exposing the second resist layer to form a second resist layer pattern revealing first resist layer portions;

dry developing said first resist layer portions according to the second resist layer pattern to reveal the substrate according to a first plasma etching process consisting essentially of nitrogen, oxygen, and argon to form an etching mask;

plasma etching according to a second plasma etching process an opening into the substrate according to the etching mask; and,

then carrying out an in-situ ashing process to remove remaining overlying resist layers selected from the group

consisting of the first and second resist layers.

2. cancelled

3. The method of claim 1, wherein the first resist layer comprises a non-photoactive polymer.

4. cancelled.

5. The method of claim 1, wherein the activating light source comprises a wavelength selected from the group consisting of about 157 nanometers and about 193 nanometers.

6. cancelled

7. The method of claim 1, wherein the first resist layer has a thickness of about 1000 Angstroms to about 5000 Angstroms and the second resist layer has a thickness of about 500 Angstroms to about 3000 Angstroms.

Claims 8-10 are cancelled

11. The method of claim 1, wherein the opening is selected from the group consisting of a via hole, a trench line, and a contact hole.

12. The method of claim 1, further comprising the step of removing only the second resist layer according to a first ashing process following the step of dry developing and prior to the step of plasma etching.

13. The method of claim 1, wherein the in-situ ashing process comprises an oxygen containing plasma and a component selected from the group consisting of nitrogen and fluorine to simultaneously clean plasma reactor contact surfaces.

Claims 14-22 are cancelled

23. The method of claim 1, wherein the first resist layer is selected from the group consisting of an I-line photoresist, an acrylic polymer, and a polyvinyl alcohol polymer.

24. The method of claim 1, wherein the second resist layer comprises a DUV photoresist wherein the silicon comprises silicon incorporated from a source selected from the group consisting of a silylation process and from silicon monomers.

25. A method for etching a semiconductor device feature using a bi-layer photoresist to improve an opening etching resolution and reduce particulate contamination comprising the steps of:

providing a non-silicon containing photoresist layer over a dielectric insulating layer to form a first resist layer;

providing a silicon containing photoresist layer on the first resist layer to form a second resist layer thinner than the first resist layer;

patterning the second resist layer according to a photolithographic exposure process comprising a wavelength selected from the group consisting of 157 nm and 193 nm;

wet developing the second resist layer to form a patterned second resist layer;

dry developing the first resist layer according to a dry etching chemistry formed by supplying gases consisting essentially of nitrogen, oxygen, and argon, to reveal the dielectric insulating layer to form an etching mask;

plasma etching in-situ an opening in the dielectric insulating layer according to the etching mask;

then carrying out an in-situ oxygen ashing process to remove overlying resist layers comprising at least the first resist

layer;

wherein, during the in-situ oxygen ashing process a simultaneous in-situ plasma cleaning process is performed comprising adding a component selected from the group consisting of fluorine and nitrogen to clean plasma reactor contact surfaces.

26. The method of claim 25, wherein the second resist layer is removed in-situ according to a first oxygen ashing process, optionally including the simultaneous in-situ cleaning process, following the step of dry developing and prior to the step of plasma etching.

Claims 27-29 are cancelled

30. The method of claim 25, wherein the first resist layer is selected from the group consisting of an I-line photoresist, an acrylic polymer, and a polyvinyl alcohol polymer.

31. The method of claim 25, wherein the second resist layer comprises a DUV photoresist wherein the silicon comprises silicon incorporated from a source selected from the group consisting of a silylation process and from silicon monomers.

32. A method for etching a semiconductor device feature using a bi-layer photoresist to improve an opening etching resolution and reduce particulate contamination comprising the steps of:

providing a non-silicon containing photoresist layer over a dielectric insulating layer to form a first resist layer;

providing a silicon containing photoresist layer over the first resist layer to form a second resist layer thinner than the first resist layer;

patterning the second resist layer according to a photolithographic exposure process comprising a wavelength selected from the group consisting of 157 nm and 193 nm;

wet developing the second resist layer to form a patterned second resist layer;

dry etching the first resist layer according to a dry etching chemistry comprising nitrogen, oxygen, and argon, to reveal the dielectric insulating layer to form an etching mask;

then carrying out a first in-situ oxygen ashing process to remove the second resist layer;

then plasma etching in-situ an opening in the dielectric insulating layer;

then carrying out a second in-situ oxygen ashing process to remove the first resist layer;

then plasma etching in-situ through a bottom etch stop layer comprising the substrate; and,

then carrying out an in-situ plasma cleaning process comprising a component selected from the group consisting of fluorine and nitrogen to clean plasma reactor contact surfaces.

33. The method of claim 32, wherein at least one of the first and second in-situ ashing processes comprises adding a component selected from the group consisting of fluorine and nitrogen to simultaneously clean plasma contact surfaces.

34. The method of claim 32, wherein the first resist layer is selected from the group consisting of an I-line photoresist, an acrylic polymer, and a polyvinyl alcohol polymer.

35. The method of claim 1, further comprising the steps of:

etching through a bottom etch stop layer comprising the

substrate; and,

carrying out an in-situ plasma cleaning process comprising a component selected from the group consisting of fluorine and nitrogen to clean plasma reactor contact surfaces.

36. The method of claim 1, wherein the dry development process, the plasma etching process, and the ashing process are carried out in a dual source RF power plasma reactor comprising an RF biasing power source.

37. The method of claim 25, wherein the plasma reactor comprises a dual source RF power plasma reactor comprising an RF biasing power source.

38. The method of claim 32, wherein the plasma reactor comprises a dual source RF power plasma reactor comprising an RF biasing power source.

EVIDENCE APPENDIX

None.

Related Proceedings Appendix

None.